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OF THE

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AMERICAN WELDING SOCIETY
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Volume 3 July, 1924 Number 7

RECOGNITION

Before recognition come many years of hard work and struggle. At first it seems almost impossible to obtain even the slightest encouragement from those that count. Then the returns from this hard labor begin to come in rapidly. As with an individual so it is with a Society or organization like ours. Fortunately, however, the cooperative effort and combined talent of some of the greatest experts in the welding field have cut down this elapse of time to a small fraction of what it would normally take for an individual. Our members will be highly gratified and appreciative of the recognition accorded to us by the Mechanical Division of the American Railway Association in cooperating with us in drawing up their Welding Wire Specifications.

We are taking the liberty of reproducing below an editorial as it appeared in the June, 1924, issue of *Railway Age*.

"FUSION WELDING"

"Uniformity is the watchword in all kinds of fusion welding. Sound welds can be had consistently when the performance of the operator is uniform, when the welding material used is correct and of uniform quality, and the best method of procedure is rigidly adhered to. The Mechanical Division is to be congratulated on the progress it is now making in the field of fusion welding. The report on specifications and tests for materials presented on Monday contained proposed specifications for welding wire and rods which were prepared in cooperation with representatives of the American Welding Society. These specifications, as they should be, are a step toward the establishment of uniformity of material, yet not so binding as to restrict progress in the art of welding. The American Welding Society has also prepared a fund of valuable information on the training of operators, and this is available for use by those who wish to take advantage of it. At a meeting conducted by the welding society on yesterday afternoon its services were offered to the Mechanical Division. The Association of Railway Electrical Engineers is now preparing a manual on methods of procedure. This will undoubtedly prove to be a tremendous task requiring much time. When it is completed, however, it will be of great value for electric welding as applied to railroad work. To the uninitiated these several activities may appear as unnecessary complications, but it is only by everyone putting his shoulder to the wheel that the work will be done. Proper coordination will prevent duplication of effort, and the inevitable result will be that the railroads can avail themselves of the full advantages offered by the use of fusion welding. The several associations should work together."

EMPLOYMENT SERVICE BULLETIN

On a number of occasions we have called attention to our employment service bulletin. As indicated in the explanatory notes accompanying this bulletin, this service is entirely free to all members, whether they be employers who seek welding talent or welders and engineers who seek positions.

To effectively maintain such a service requires the cooperation of all our members. If you are out of a job, let us know about it and give us your qualifications. If you need welders or welding engineers, a note to that effect will bring prompt attention. In either case your needs will be published in the next issue of the Journal of the Society. Moreover, every effort will be made to fill vacancies and to secure positions from such information as we already have on our records.

MEMBERSHIP DRIVE

While the efforts of the Membership Committee in its recent drive to secure new members in time for inclusion in the first membership directory of the Society was partially successful, nevertheless a great deal remains to be done in this field.

As our Past President Barton pointed out in his retiring address, this work cannot be carried on by a chosen few called the Membership Committee. It requires the cooperation of every member. Up to this time, these drives have been somewhat handicapped by lack of knowledge on the part of the membership at large, of those who were already members of the Society.

With the publication of the first directory as the August issue of the Journal the above handicap will be removed, and every member is earnestly requested to study this directory and to select at least two of his friends, whose names are not included, for a personal membership drive. Complete information on the Society and its activities will be included in the directory. Extra copies may be obtained upon request by writing to the Secretary. In this way it is hoped that every prospective member of the Society will obtain a copy of this directory, as we feel that if such prospective members study the information contained therein carefully, they will be convinced of the advantages of joining the Society.

WELDED RAIL JOINT ACTIVITIES

That the summer months are not slowing up the activities of this important committee is indicated by the fact that the Executive Committee will hold a meeting at the Bureau of Standards on July 18th. It is hoped that the preliminary series of tests to determine the present state of the art will be completed and a final report rendered in time for the street railway convention in October. Practically all of the bend and drop tests have now been made. Tensile tests were delayed because it was necessary to move the large Emery testing machine at the Bureau of Standards to its new location. The Bureau of Standards reports that testing will probably be started on the 1st of August and carried on continuously until completion. The repeated impact testing machine is now in successful operation and will be inspected by the Executive Committee at the meeting on the 18th. On the preceding day a committee of experts will examine the broken specimens now located at the Bureau of Standards with the hope of obtaining further information on the quality of welding, causes of failure and how the joints may be improved.

At this meeting a program of further investigations will be prepared. If the efforts of the Committee will prove successful in increasing the life of the street railway joints twenty-five per cent, there will result an annual saving to these street railways of $15,000,000.

SECTION ACTIVITIES

Philadelphia

The Philadelphia Section has the honor of being the first section to prepare its program for the coming year. This program is reproduced below:

PROGRAM OF THE AMERICAN WELDING SOCIETY,
Philadelphia Section, 1924-25

Sept. 15, 1924—Motion pictures and paper by H. H. Griffith, of the Oxweld Acetylene Co., entitled "New Applications of Welding and Cutting by Oxy-acetylene Process."

Oct. 20. 1924—Motion pictures and paper presenting "The Possibilities of Thermit, Past, Present and Future," by J. H. Deppeler, chief engineer, The Metal and Thermit Corporation.

Nov. 17, 1924—Slides and paper presenting "Progress of Safety in Welding," by Col. Royal Mattice, president, Mattice Engineering Company.

Dec. 19, 1924—Philadelphia Night. "The Effect of Annealing Upon the Crystal Structure of Cold Worked Steel," presented by Dr. George L. Kelly, metallurgist, Edw. G. Budd Mfg. Company.

Jan. 19, 1925—Illustrated paper. "Some Applications of Butt and Spot Welding in Modern Industry," presented by Mr. Woofter, electrical engineer, Thomson Electric Welding Company.

Feb. 16, 1925—Illustrated paper. "Molten Metal in an Acetylene Atmosphere," presented by Prof. A. S. Kinsey, of Stevens Institute of Technology.

March 16, 1925—Illustrated paper

by the Linde Air Products Company. Speaker and subject to be announced later.

April 20, 1925 — Illustrated paper, "Welded Pressure Vessels," presented by S. W. Miller, past president national body, American Welding Society.

San Francisco

The June meeting of the San Francisco Section was held on the 20th. M. A. Wright, of the Western Pipe & Steel Company, presented a paper on welding tanks, with particular reference to the automatic arc welding machine.

EMPLOYMENT SERVICE BULLETIN

Opportunities.—The Society is glad to learn of desirable opportunities from responsible sources, announcements of which will be published without charge in the BULLETIN.

Services Available.—Under this heading brief announcements (not more than seventy-five words in length) will be published without charge to members. Announcements will not be repeated except upon request received after an interval of three months; during this period, names and records will remain in the office reference files.

Note.—Copy for publication in the BULLETIN should reach the Society's Office not later than the thirtieth of the month if publication in the following issue is desired. *ALL REPLIES should be Addressed to the Number Indicated in Each Case and Mailed to Society Headquarters.*

Positions Vacant

V-16. Manager wanted to take charge of Chicago office of manufacturer of electric welding equipment. Should have (1) intimate knowledge of electric welding, both arc and resistance, (2) experience in sale of electric welding machines, preferably, but not essentially, in the Chicago district. Please cover these points fully in your first letter.

V-18. Acetylene welder wanted in Philadelphia, experienced in all metals. Full particulars first letter, hourly rate and names of employers for past three years. Electric welding knowledge helpful but not essential. Expenses refunded if competent after three months.

V-19. Electric welder wanted in Philadelphia with cast iron experience. Full particulars first letter, hourly rate and names of employers for past three years. Acetylene welding knowledge helpful but not essential. Expenses refunded if competent after three months.

Services Available

A-23. Welder desires position. Have taken the General Electric Training Course and have had five months' experience with the General Electric Co. on welding wheels, oil switch vessels, gear cases and welding tanks with semi-automatic welding machine. Have also had four years' experience with Ferrocarril Central Dominicano R. R., welding oil tanks, building up shafts for locomotives, frogs, cast iron gears, locomotive frames, etc.

A-24. Acetylene welder desires work in Philadelphia or vicinity. Have had four years' experience in welding all metals.

Standard Time for Production Welding

JOS. W. MEADOWCROFT*

The study of the proper time in which to do a welding operation is peculiarly difficult when same is done by hand, as the element of human judgment and human skill enters so largely into hand welding that even the closest study will at times fail to give an altogether scientific analysis of the quickest time in which any particular job should be performed. After a welding operator has been on the same welding job for a number of years, his operations become automatic and can be made at a rate of speed that cannot be equaled by any operator whom the superintendent may select to try out the job, unless he has had an almost equal term of experience. A study with the stop watch of the length of time required to weld various operations will often prove fruitless because if the welding operator has the slightest suspicion that he is being checked up he will immediately slow up his pace. If the welding operation is on a piece work basis or a bonus system, the proposition becomes more difficult, for the welding operator well knows how to keep down his rate of speed. It is for this reason that the study of welding operations requires particular care and especially keen analysis.

The time study of welding operations should be done only by men who are thoroughly familiar with welding operations, as it is due to the efficiency and economy in all methods of welding that the welding art is coming into its own today. To procure this efficiency and economy in welding it is also necessary to have all welding operations supervised by men who are authorities in this class of work so that the time study men can cooperate with the welding men when setting a time allowance. It is of much importance, when welding various articles composed of intricate parts, to separate the operations into as small a number as possible. Each and every operation should be inspected so that the accuracy of the previous operation can be assured. The inspectors should also be men who have had more or less training in the art of welding so that at various time periods they can make an inspection of the welds as they are being made and not after the welds are finished. By handling the inspection of welds in this manner the inspector not only holds the quality of the welds to a high standard but assists the welding operator, regardless of the operation, to become more efficient in producing quantity and quality.

Every possible facility should be provided for the quick handling of the part or parts regardless of the welding method to be used and all problems should be given very careful consideration, using every possible method to solve them scientifically, which will, without question, bring surprising results. I have often noted very large savings of time in welding operations which were performed at a high rate of speed, and which were worked under the piece

*Superintendent of Welding, E. G. Budd Mfg. Co.

work system. For example—the benefits of the system advocated, taken from my own experience, may prove of interest at this point. Some months ago I witnessed a welding operation which required two operators, four helpers and two machines. The men and equipment together produced 600 pieces in a ten-hour working day. As a result of a time study made of this operation with the welding supervisor, the operation and rate was changed, and now 700 pieces are produced in a ten-hour day, with one operator, one helper and one machine doing the operation.

Setting Piece-Work Prices for Welding Operations

Always try to get the price right at the beginning of the job as it means trouble to change it.

Welding operations on intricate parts need your utmost attention as it takes many days before said work can be done quickly. However, it is surprising to see the speed at which the welding operator can weld intricate parts after he becomes experienced. Start an operator on a welding operation and after a week's work he will have increased his speed 50 per cent or more. I have seen some welding operators increase their production 300 per cent in a week's time.

In setting piece work prices on welding operations it is a good policy to tell a man what you expect him to produce and inform him of this in as few words as possible. Operators should be advised to the effect that when prices are set they are very rarely set under normal conditions, and it is consequently necessary from time to time to make adjustments in prices. We should make a careful analysis of rates before adjusting as we may slight the quality of the welds for the sake of making a reduction in the cost. This item is one of vital importance, as a welding operator doing hand welding can very easily increase his speed of welding and yet slight the weld materially.

In machine or automatic welding operations, the piece work prices can be placed on work without any fear of mistake and adjustment of prices should not be necessary unless the machine is not in first class shape, or inferior material is being welded. One other very vital factor in the welding industry is the cost of labor turnover. Labor turnover can be explained by the difference in the cost of an operation when performed by one operator for a year, and when done by fifty operators in a year, or a new man each week. This is an exaggerated condition, but fully explains the case. Once the value of this is understood, one can realize the importance of holding welding operators to their jobs.

In making an analysis of the situation, we find that in order to get the welding operator to produce efficient work it is necessary to have him concentrate on his particular work, and in order to concentrate, he must be interested in the work. There must be an incentive to produce interest regardless of the classification of

welding operations. Just what constitutes an incentive is not always clear in the minds of all concerned, so I will give just one example. Some welding operators would consider a well lighted, well equipped workshop an incentive, and they would naturally enjoy working in it, doing their best to give good results. This may or may not be true, yet it cannot be denied that a plant of this character is pleasant to the workman and a credit to any individual or company, but it can only be viewed as an incentive when all other conditions are equal.

Some years ago when piece work was first placed on welding operations it was said by many to be the absolute failure of the welding industry, but it has proved successful and is now looked upon as a big factor toward solving the wage question. It is considered to be as near perfect as it is possible to be. It has proved conclusively that it is possible to advance the interest of the employer and the interest of the employees (welding operators) at one and the same time, a thing heretofore considered unattainable. The piece work system enables the operators who work hard, using their brains, to earn more than their fellow workers who do otherwise.

Welding of Manganese Steel

Discussion of Mr. Miller's Paper

J. H. HALL*

As a representative of the Taylor-Wharton Iron & Steel Company, which furnished the samples with which Mr. Miller worked, I wish first to congratulate Mr. Miller on the excellence of his paper. It is a great gratification to us to see such an able piece of work so well presented.

I wish to ask Mr. Miller how these welds stood up in a bending test.

(In answer Mr. Miller stated that but few tests had been made and that the welds were not very tough or strong. Further work is to be done and Mr. Miller expressed the conviction that he would be able to produce welds as strong and tough as the manganese steel itself.)

That is just the point which I wish to bring out here. We have been experimenting with the welding of manganese steel for a number of years, using both the torch and the arc, and we have found that it is possible, as Mr. Miller has shown, to secure a weld with correct composition and correct microstructure, but these welds as a whole are nowhere near as strong and tough as the unwelded manganese steel. The reason for this is that the manganese steel near the weld is damaged by the heat of welding in two ways. Mr. Miller has shown one of these ways in Fig. 9 and has also shown you that this damage, which occurs some little

*Metallurgist, Taylor-Wharton Iron & Steel Co.

distance from the weld where the manganese steel is heated to a comparatively low temperature, can be corrected by reheat-treating. Our experience is the same as Mr. Miller's, that the steel at this point can be completely retoughened.

There is, however, another damage which is done to the manganese steel close to the weld and that damage is true burning of the layer of steel adjacent to the fused metal, which is heated to about 1200 deg. C. The steel at this point is heated above the solidus, but below the liquidus, and we have found by careful tests on pieces of manganese steel heated to this temperature, that the steel is made weak and brittle by this burning. Moreover, although a reheat-treatment at 1060 deg. C. will restore the burned steel to the austenitic condition so that it looks all right under the microscope, yet we find that its toughness is only in part restored, and it is the weakness of this burned zone close to the weld which we regard as the reason for the lack of success of all welds so far made in manganese steel.

I think Mr. Miller's impression that the manganese steel is not very tough arises from the fact that what he is testing is not the original metal, but the manganese steel which has been burned by the heat of welding. We have found that whereas a ¾-in. square bar of manganese steel should bend 140 to 180 deg. without fracture, a welded bar will never bend better than about 60 deg., the failure taking place in the burned manganese steel close to the weld. The tensile strength is reduced nearly in the same proportion.

(Mr. Spraragen questioned the accuracy of the statement that the tensile strength would be reduced to about one-third of the original manganese steel. He mentioned that in the welding of ordinary steel, while the angle of bend in many of the welded specimens was not more than one-third of the original steel before fracture, nevertheless it is possible to obtain welds nearly equal in strength to the parent metal.)

There is no question that the strength of the manganese steel close to the weld is very much reduced by the heat of welding. You are comparing the strength of the weld metal with the strength of the damaged manganese steel rather than with the strength of the original manganese steel.

If Mr. Miller is able to find a way of restoring the toughness of this burned zone, no one will be more delighted than the makers of manganese steel castings, and I wish to assure Mr. Miller that we stand ready to assist him in every way in this work. We have been working on the microstructure and heat treatment of manganese steel for many years and we feel that we can be of great assistance in furthering this valuable work.

Welding Gasoline Tanks

B. S. HAVENS*

Thru the application of the automatic arc welding machine, the Wayne Tank and Pump Co. has effected large savings in assembling underground gasoline tanks. With the automatic installation production has been increased to 75 ft. per hour as against 7 ft. by their old welding process.

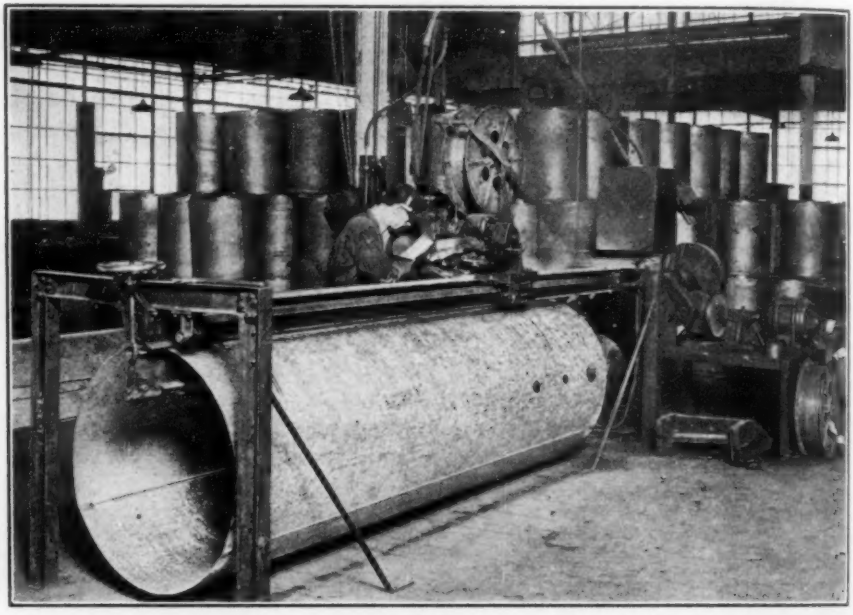

Fig. 1. Automatic arc welding head in operation welding tanks

These tanks are made from ⅛-in. galvanized sheet iron cut in three sections with the assembled tank having three seams each 120 deg. apart and 116 in. long. The circumference of each tank is 118 in. The automatic welding machine used in assembling these tanks consists of the framework for holding the tank in position and for carrying the automatic welding head and electrode supply. The joint to be welded is placed between two clamping bars and a backing-up bar. Along this seam travels the automatic welding head which feeds the electrode wire to the arc.

The procedure of welding is to tack each of the longitudinal seams at either end by acetylene, each of these two tack welds being approximately 3 in. long. The plates are placed about ⅛-in. apart before tacking, but draw up tight when the gas tack is completed. Following this, they are placed on the automatic forms and the arc struck at one end and allowed to continue without breaking to the opposite end. Then the clamps are released and

*General Electric Co.

the tank rotated one-third of its circumference to the next seam and the automatic head welds the next seam on its return. The clamps are again released and the tank rotated to the third or last seam which is welded in the same manner as were the two previous seams.

Beside the time saving another favorable factor is that the galvanizing on the inside of the tank adjacent to the weld is in good condition. The money saving in operation was such that the entire cost of installation was paid for the first two months of operation.

Welding in Bridge Repair

B. S. HAVENS*

An operation of interest to the engineering profession in general and structural engineers in particular was recently completed in the reinforcing and building up of bridge members eaten away by extensive corrosion. The bridge in question is located at Pittsburgh over the Allegheny River, connecting Herrs Island with the

Fig. 1. Repairing bridge by arc welding

North Shore and is a 240 foot through truss, pin and linkspan, built about 31 years ago.

The floor of the bridge was carried on timber stringers supported on cross timbers bolted to the web of the floor beams. While the upper portions of the structure are still in a good state of preservation, the parts rendered inaccessible to paint and kept constantly moist by the proximity of the timber were so greatly

*General Electric Company.

reduced in section as to be perforated and, in many places, almost severed. The webs of the floor beams and bottom of vertical posts suffered particularly, being reduced from 3/8-in. in thickness to 1-32-in. over a large area.

It was decided to renew the entire floor by cutting away the

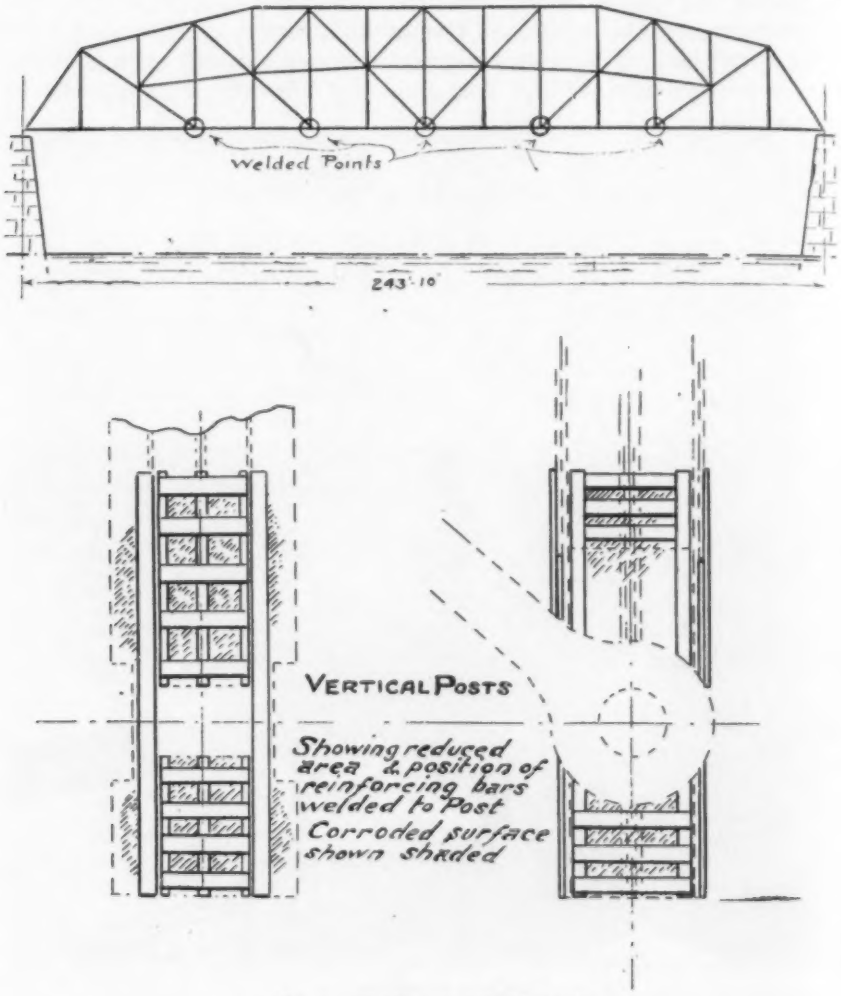
Welded Points
243'-10"
VERTICAL POSTS
Showing reduced area & position of reinforcing bars welded to Post
Corroded surface shown shaded

Fig. 2. Welding in bridge repair

floor beams and sidewalk brackets from their connection to the vertical posts. This operation presented no very unusual difficulties. The strengthening of columns, however, was a more serious problem. These were compression members built of Z-shaped bars and web plate, and directly above and below the pin bearing plates were found to be perforated and reduced in section over 60 per cent.

The difficulty was overcome, both economically and efficiently,

by welding, using the electric arc metallic process. The method adopted by the Pittsburgh Welding Corporation, under the supervision of the engineering department of the city of Pittsburgh, was to weld strips of steel, 1 in. by ½ in., extending from the bottom of the column to a point well beyond the corroded portion. After the surface of the original metal had been thoroughly cleaned by use of the acetylene torch, scrapers and wire brushes, the bars were welded into position vertically, and tied together at close intervals with crossbars of the same section. After each point was completed, the strength of the weld was tested by subjecting the bars to a number of blows with an eight-pound maul. Results of physical tests showed practically no deterioration of the original metal when welded by this process.

Report on Welding of Pipe

By G. O. CARTER*

As Chairman of a sub-committee of the Gas Welding Committee of the American Bureau of Welding, I have been impressed with the importance of the managerial and organizational side of the welding of pipe lines as well as the technical features involved. In this paper, I am particularly stressing these phases of the subject from three points of view:

1. Very extensive welded pipe lines.
2. Extensive plant and installations.
3. Small plant installations.

In the first classification the work is done across long stretches of country where the apparatus must be steadily carried along as the work progresses and where the welding crews must be moved at frequent intervals. In the second there may be a total of many miles of welded piping, however, the work is all concentrated where the welding equipment will not be frequently moved and where it can be carefully managed.

A third situation is one which to us involves a great deal of welding in the aggregate, but in any given job there is only a small amount and, therefore, this welding must be more carefully watched.

The Welding of Long Oil and Gas Lines

With regard to the welding of long oil and gas lines, the history goes back to 1911, when the first gas line was welded in Chester, Pa. This was so successful that in 1914 that company adopted welding as a standard method of joining pipe. About the same time Oxy-Acetylene welding of pipe was tried in several other parts of the country—the results were not consistently good

*Consulting engineer, Linde Air Products Co.

and introduction of welding was delayed on that account. The failure of several of the earlier welded lines was due to poor workmanship, which in turn was due to the failure of the management of the respective companies to select good welders and to test the finished work.

It is notable that welding was successfully introduced on the Pacific Coast in 1914, and the companies introducing welding around San Francisco and Los Angeles have increased their use of the process ever since. Welding on the West Coast was started under capable management and has been well managed.

The welding of long lines attracted considerable attention prior to the World War among men interested in gas distribution, due to the success of the lines in Chester and San Francisco. However, little more was printed about welding long pipe lines until the Prairie Pipe Line Company welded an 8 in. line, 140 miles in length in Texas. This was such an outstanding achievement that it received a great deal of publicity and the whole subject of welding long lines was brought very prominently to the fore. There is now very little question about the desirability of welding long oil pipe lines if welders can be procured to carry the work on as fast as it is usually desired that such lines be constructed.

At the time of writing, an 8 in. line, 180 miles in length, is being constructed in southern Texas at a rate fully equal to the rate of construction achieved by screwing the pipe. Each of three gangs of welders, comprising 21 welders to a gang, is averaging a mile of welded pipe per day. It is noticeable that no great difficulty was experienced in securing sufficient welders for this work. A general slowing up of industrial and railroad work throughout the country may have had some effect on this situation, but it is believed that the number of good welders is constantly growing. Those contemplating the welding of long lines will be readily able to secure or train sufficient men for the work.

In planning a long Oxy-Acetylene Welded Pipe Line a company must, of course, secure its right-of-way and buy the necessary pipe. At this same time orders should be placed for the Oxy-Acetylene welding equipment and supplies. The character of the country will determine whether generated or dissolved acetylene shall be used. Most of the recent long lines have used a considerable quantity of generated acetylene, which is supplied from portable generators mounted on farm wagons, which are pulled along the right-of-way or are stationed at proper intervals to supply the welding crews. However, a part of each of recent installations has been welded with dissolved acetylene, particularly those joints called "Tie-ins."

Where generated acetylene is used, arrangements must be made for carbide. In all cases, oxygen welding apparatus and filler rod must be secured.

The rate at which pipe is to be laid will determine the amount

of welding equipment needed and also how large a welding crew should be used. It is obvious that if a line is relatively short, say ten miles in length, one crew of ten or twelve men will be able to complete the work within thirty days and it would be easy to organize a crew of that size. On the other hand if an effort were made to secure a crew of twenty or more men, the work would hardly be organized before it would be completed and this would run up the expense.

In long lines of 100 miles or more it would probably pay to have two or three welding crews of twenty men each. As it is easy to handle crews of about twenty welders and furnish them with the necessary supplies, it is advantageous to start the work at several widely separated points, instead of having crews of forty or sixty welders working at a single point. This, of course, has an important bearing on the orders for delivery of pipe and materials, also the laying out and purchase of the right-of-way and the progress of the ditching.

Obtaining proper welders in sufficient number is a most important problem in the welding of long lines. The first thing to consider is obtaining proficient men. Therefore, all candidates should be tested for workmanship. It is recommended that the candidates be required to weld pipe similar in weight to that which is going into the long line. As there are two kinds of work it may be well to separate the welders into two classifications. A large part of the welding is done with the pipe being so turned that the welding is always on the upper part of the pipe, but fully 20 per cent of the welding must be done with the pipe in position. It is obvious that some welders may be able to make entirely satisfactory welds on the upper part of a joint, but would not be able to weld completely around the joint. Therefore, the first class men should be the "Tie-in" men, who would be competent to weld around the pipe, whereas the second group would be welders who were capable of making a satisfactory "rolling" joint.

It is preferable to have the candidates tested at some base point where the Company's Employment Department would also handle the usual employment work, such as signing up to comply with State Compensation Laws, etc.

The test of a welder's workmanship is to cut strips of 1½ to 2 in. width from the finished weld, place the strips in a vise with the weld flush with the top and then bend the test piece with a hammer or sledge, hitting from the side opposite from which welded. This test immediately indicates whether or not a welder has secured full penetration with the welding flame and if he has deposited good metal.

If sufficient skilled welders are not readily obtainable, it will be necessary to train men who have had some welding experience, but whose workmanship is not quite satisfactory for pipe welding

work. There are a great many welders in the country who are good welders but lack experience in pipe welding, which can be given them in a simple, intensive training on pipe welding.

There are several ways of welding, such as the forward or ripple weld and the backward or flat weld. If a man is competent to make a good weld by any of the processes, he should be considered suitable, unless his rate of welding is so slow as to make him entirely unsatisfactory. Once welding crews are organized, it is, of course, advantageous to match men so that those having equal rates of welding will be working together.

Consider now that a crew has been selected and is being assigned to field work. It may be necessary to run a camp for these men. As a general thing, boarding places may be found in nearby towns and men transported to the work. Each man should be given a welding outfit, including a torch and necessary regulators and should be held accountable for their condition. Arrangements should be made for storing the equipment on the right-of-way at the end of the day's work.

From a dollars and cents standpoint, it is advantageous to make as large a proportion of "rolling" welds as possible. Present practice is to put five sections of pipe together with one gang of four welders, although, if everything is satisfactory, one or two more can be conveniently used in a gang and it will pay to do so. The organization of a welding crew is necessarily dependent upon the generating equipment or acetylene supply and upon the thickness of steel being welded, and will have to be worked out for each particular condition by Oxy-Acetylene Engineers.

Of course, a sufficient amount of welding must be got from each crew to keep the cost within reason, but at the present time the costs of joining pipe by Oxy-Acetylene welding are as favorable as joining by any other means. Bad management may, of course, result in very high costs.

The use of acetylene generators requires a considerable quantity of water. Furthermore, the moving of the generating equipment is an important transportation problem. These are connected with the welding but are not in themselves welding problems.

After a section of the pipe is completely welded, it should be tested. At the present time cold water test up to the full working pressure of the line is quite general. The most effective test, however, would be the combined use of water pressure and impact from a hammer or sledge at each joint. This can only be applied in relative short lengths of a mile or two before the pipe is lowered into the ditch and is, therefore, difficult to carry out.

As welded lines are put in the ditch, there should be a sufficient amount of slack to take care of contraction during the cold months of the year. It is, therefore, good practice to lower the pipe into the ditch when pipe is cool and slack should be crowded into the

ditch, just as has been the practice with screwed lines for many years.

Once a properly made Oxy-Acetylene welded line is in the ditch, it should remain tight for years. Therefore, the companies installing such welded lines are spared the expense of pipe walkers, the installation of expensive telephone systems and the payment of heavy damages, through oil or gas leakage, such as has occurred with other types of lines in the past.

The Welding of Large Plant Installations

When new factories, mills, chemical plants and plants of various kinds are built there is usually a great amount of piping to be installed which in the aggregate will total many miles. Such piping is used for carrying steam, water, air and other substances.

In the past this piping has been made by screwing pipe sections together or by bolting with flanged connections. The mere substitution of Oxy-Acetylene welding for such joints does not, therefore, change the fundamentals with regard to suspension of piping nor the provision for expansion and contraction.

It is now generally recognized that the properly made welded joint is superior to any other pipe joint and the problem here resolves itself to workmanship, testing and cost. Frankly, all three of these are a matter of management.

If construction work is going to take many weeks or months, it may pay a company to organize its own welding crews. A safe rule to follow in that regard is that if the plant will have a boiler shop when it is in operation, it should have a trained crew of welders to work under the boiler shop foreman. If, on the other hand, the plant would not have an organization familiar with boilers and such pressure vessel work, it would, undoubtedly, be better to have the pipe installation work done by qualified contracting firms which are thoroughly experienced in such work.

Many managers do not appreciate the importance of having absolutely tight piping nor do they appreciate the relative amount of money which is spent on piping. A big power plant will require almost a million dollars worth of piping.

The practice of welding big installations is growing very fast. Two of the largest companies in the country are using Oxy-Acetylene welded joints exclusively in their new pipe construction, and several lesser and almost as prominent concerns have recently put in all-welded pipe systems.

Oxy-Acetylene Welding in Small Installations

There are literally thousands of places where small piping installations could advantageously use welded joints. Sometimes only a single weld is needed, but other times there may be fifty or even a hundred. Where the amount of welding is limited, it should be given very careful consideration.

There is a tendency in many places to call in a local welder

for this work because he is running a welding shop and is, therefore, believed to be competent. However, pipe welding is one of the newer developments which has gone forward along specialized lines rather than as a general development of the industry. There are, therefore, many local welders who are competent to do steel welding but who lack pipe welding experience. The qualifications of a local welder are, therefore, a question to be specifically looked into rather than assumed generally.

Provided a welded joint is not to be used, how would small installations be made? An answer to this question may give us the answer as to how the work should be let for welding.

If flanged joints are used it is certain that the work would have to be contracted to a piping concern. Again, if pipe had to be cut to length and threaded, it would probably be contracted out, although some machine or repair shops carry a set of dies. It being necessary to call in piping contractors for the usual modifications in pipe systems, why should such contractors not be called in for making welded installations?

The same situation exists when obtaining fabricated structural steel. We find that there are very few places which undertake to fabricate their own roof trusses, columns, girders, balconies, etc., but they send sketches or drawings to some local fabricating shop. In the same way sketches or drawings of desired pipe manifolds or other installations should be sent to piping contractors for estimating and fabrication, only the tie-in welds being made on the purchaser's premises and that work done by the contractors competent men.

Of course, the cost of welding quoted by piping contractors would seem high compared with the costs given in many tables estimating the actual welding of a joint. Such tables include no supervision, organization, overhead or profit. It must be recognized that if a company's engineer would put in considerable time studying this problem and assisting a local job welder and this time charged against the job, it would make the cost very high. So, if you compare the cost of the properly made Oxy-Acetylene welded joint either by a closely supervised welder or by a good contracting firm you will find that it is as cheap as a screwed or flanged joint.

The cost of making the other joints of various sizes are quite in line with the cost of welding the thickness of metal used in the pipe. If the pipe is turned slowly the speed of welding is approximately that for welding flat seams. If, on the other hand, a welder must go around the joint, the speed of welding will be about half that for a flat seam.

The labor cost of welding the joint is one factor that may be determined with a stop-watch when checking the gases and filler rod used. The total cost of the welded joint is, however, another matter and includes the labor for lining up, the necessary time

for tacking the pipe, moving of equipment and the supplies used in the welding. The cost of testing is also a part of the cost of the welded joint. The cost of the welded joint, is, therefore, a great deal more than the cost of welding the joint. There is much more chance for poor management to run up the cost of the welded joint than there is for the running up of the actual welding cost.

General Comments

Practically all pipe in use in the country at the present time is made of low carbon steel, that is, under 25 per cent carbon. Some of this pipe is made by the open hearth process and some by the Bessemer process, which latter probably contains quite a few non-metallic inclusions which affect welding to some extent. But on the thickness generally used in pipe work, it does not seem to seriously affect the strength of the joint, unless the pipe must be bent. Where welded pipe is heated and bent, the open hearth pipe has been found most suitable. Norway filler rod or suitable low carbon filler rod may be used for welding the low carbon steels.

Some pipe is now being produced from medium carbon steel up to 0.50 per cent carbon. Such pipe should be welded with nickel steel or special high carbon alloy steel filler rods, to take full advantage of the strengths of the pipe.

One reason much pipe has been welded during the past five years has been the pushing of the welding process by the Supply Companies. A few contracting firms have done splendid work in introducing welding. As a general thing, Oxy-Acetylene Engineers have taken the subject up with those contemplating pipe installations, calling attention to the advantages of welding and from then on the inherent worth of the Oxy-Acetylene weld has been the controlling factor.

There have been many opposing influences, notably from the companies making pipe couplings who have seen their business jeopardized and have, therefore, done all that they could to dissuade those in the gas industry from undertaking welding. Undue corrosion of welded joints has been suggested, but it is now recognized that the corrosion of weld metal is as slow as the corrosion of ordinary base metal.

Welding is now so generally in use that it seems that anyone putting in a piping installation should give it a thorough consideration and whenever a decision is made in favor of any other type of joint, any member of the American Welding Society who learns of it should communicate with the Secretary of the Society so that the welding engineers may get in touch with the situation. When a few pioneers have carried work such as Oxy-Acetylene welding of pipe past the experimental stage, it then becomes purely a matter of overcoming inertia in order to get it established as a recognized practice, but we must all remember that there is a terrific inertia in such practical work as pipe installation.

Welding Practice in an Oil Refinery*

By C. R. PRICE†

In an oil refinery the welding is over 50 per cent pipe work, the remainder being divided up between boiler and tank work, structural iron welding and general repairs.

As to the straight pipe line work—we find that we can make twice the speed with machine beveled pipe that we can with hand beveled joints. The latter is always irregular enough that considerable extra welding material and time are needed to fiill up the inequalities. Machine beveled pipe, if you butt it up with a couple of ⅛-in. welding rods in between for spreader, is automatically lined up. Where the ground is uneven we use a home-made clamp (Fig. 1) to hold the pipe in line until it is tacked. The quick opening handle used in place of a nut enables the welder to put on or take off the hot clamp in a few seconds without discomfort.

To mark pipe for a square cut we wrap a rectangular sheet of thin galvanized iron around it, or turn it on rollers, taking care that the pipe does not move endways while turning. If the pipe is very dirty, as occasionally in welding old pipe, we use a template (Fig. 2) consisting of a collar bored out to fit the pipe, then split lenghtways into two halves, and hinged. The method of boring, causing the collar to touch the pipe only on a ⅛-in. width ring at each end makes it possible to get a square cut on dirty pipe. The square cut facilitates welding pipe in straight lines, and so is not important where you are going to "throw" it (as in ordinary pipe line work, to allow for expansion and contraction.

In lining pipe in the shop we use rollers made like shown in Fig. 1, with roller bearings cut from 3-16-in. high carbon steel welding rods. These rollers will take all sizes from 2-in. to 12-in. The advantage of these is that the pipe turns easily without a jerky motion that would interfere with continuity of welding.

Where we have to weld heavy pipe in confined places such as a heat exchanger, we use horses with a roller top. The roller is a 4-in. pipe with a cast iron bushing screwed into a collar in each end. The bushings are bored out to turn on a 1½-in. extra heavy pipe.

Flanges: On low pressure welded work (not over 200 lb.) we use flanges cut to standard dimensions out of boiler plate. We formerly used the method shown in Fig. 3. The main drawback to this pattern is that in preheating the flanges for the weld "A," it is hard to get the flange molten without burning the pipe. The method suggested in the May, 1923 bulletin of the A. W. S. (Fig. 4), was then tried, but this involved a lot of welding that seemed to add little to the strength of the joint. One of the welders sug-

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gested trying the joint shown in Fig. 5. This we adopted. In making the weld "A," the preheating flame can be manipulated much more easily than with the other designs, to synchronize the melting of the thick flange and the thinner pipe, since the corner of the flange is the easier part to fuse.

One advantage of a weld at "A," is that it partly counteracts the tendency the weld "B" has to warp the flange.

We weld "A" and "B" at the same time, using two welders. This saves gas and cuts down contraction strains.

We have abandoned various designs of flange weld that employ bevels of pipe or flange that form an included weld-angle of less than 90 deg., because a welder will either have cold shuts at the

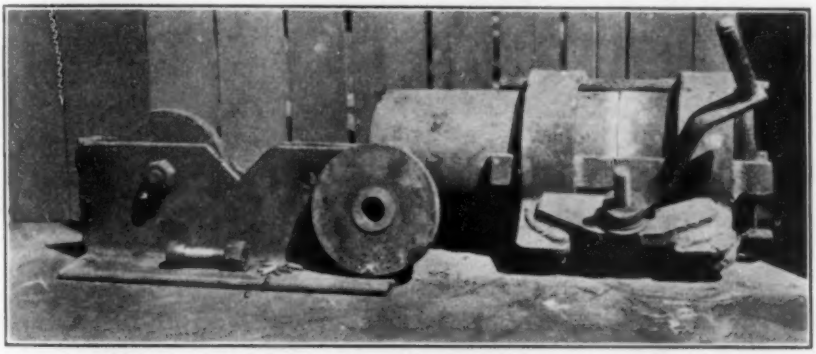


Fig. 1. Left hand figure is roller for turning pipe for welding. Right hand figure is clamp for holding pipe in position

bottom of the vee or else he has to melt out a large amount of flange metal to get a sound weld.

On 4-in. pipe and smaller, on pressures up to say, 100 lb., we weld only on the pipe side of the flange. This is strong enough. Although it causes a convexity of the face of the flange, no harm is done. The effect is merely to give an extra pressure on the ring gaskets when the flange bolts are drawn up.

Usually the flange faces on 6-in. and over, are true enough so that facing is not necessary. If it is required, we face it either in the lathe or the pipe machine. The pipe machine job is by far the cheaper to set up—substituting a facing tool for the cutting-off tool. The only drawback to the use of the pipe machine is that you can't handle a pipe with flanges on both ends unless the flanges are small enough in diameter to get through the revolving barrel of the machine.

What we would like to have, however, is a portable flange facing machine similar in principle to the portable boring bar used in railroad repair shops, so that welded flanges could be faced automatically square with the pipe with a minimum of handling.

Elbows and tees are made either with the regular threaded flanges "bucked up" tight on short lengths of pipe by means of

the pipe machine, or with plate flanges welded on. Elbows are made in from 2 to 4 sections. To square up the elbow flanges, one of them with first section attached is bolted to face of a standard cast iron elbow that is setting on a surface plate. (Fig. 6.) The other flange and nipple rests on the surface plate. Thus the two faces are automatically squared up. Correct height is also thus secured if you are making standard measurement fittings.

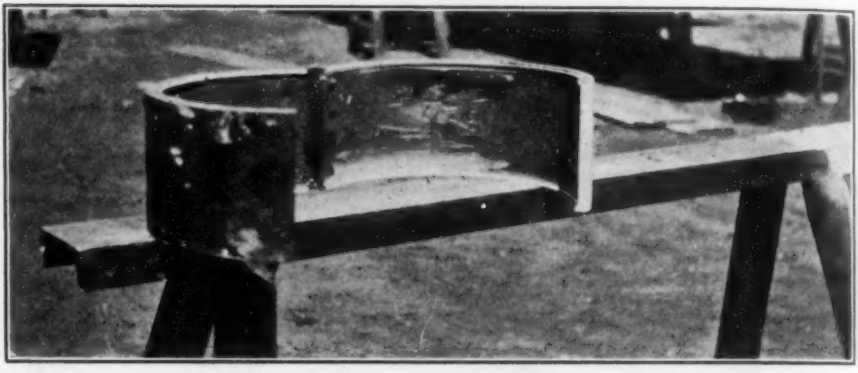


Fig. 2. Template for making square cut on dirty pipe

To get any other special height you block up under either the casting or the flange of the welded fitting. Note that a piece of heavy hack saw blade is laid under the flange of the welded ell in such a way that the angle between the faces of the ell becomes slightly

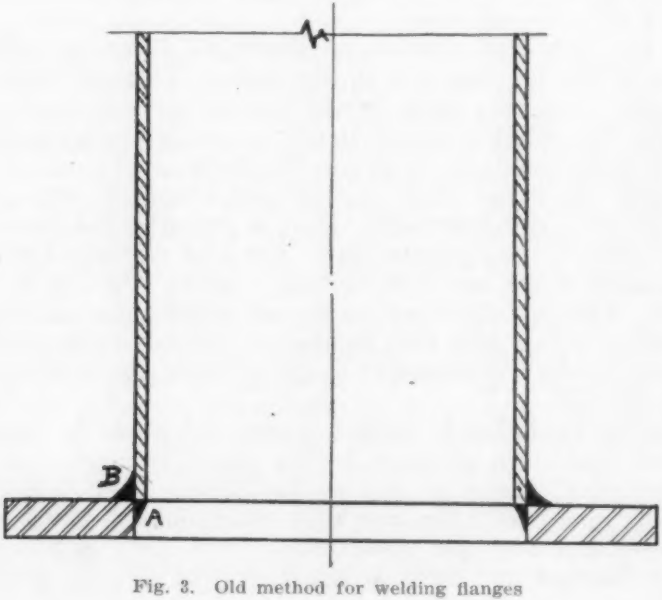


Fig. 3. Old method for welding flanges

over 90 deg. The reason for this is that even when welding in the most favorable way, contraction tends to draw the elbow flanges toward each other. This, and the statements that follow apply more to the two-piece ell than to the three and four-piece ell.

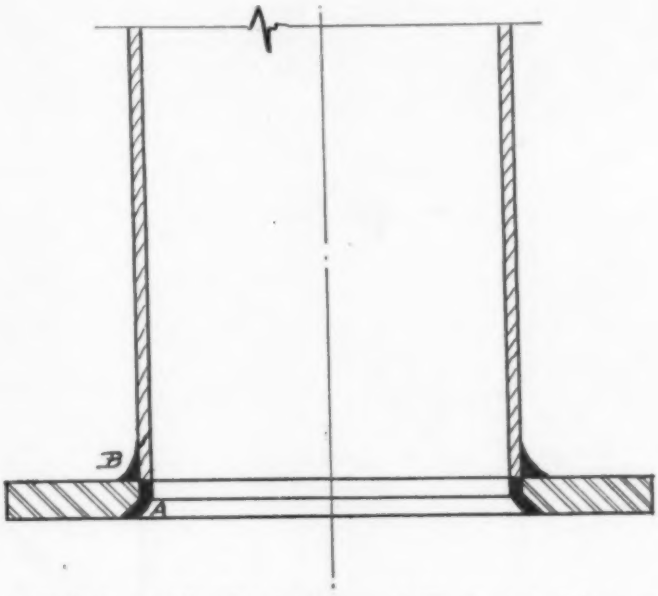


Fig. 4. Method of welding flanges recommended in Journal of the A. W. S.

To overcome this tendency we always weld from the inside out, as shown in the diagram. (Fig. 6.)

If, after these precautions, the elbow angle is less than 90 deg., we drive a block and wedges between the flanges, and heat the outside of the ell. When the heated part cools, the flanges will be found to have pulled outward and the elbow angle will be greater. The reason is as follows: Expansion at "A," if there were no blocking at "B," would have moved the flanges toward each other like the jaws of a steel trap. Cooling and contracting "A" would have caused flanges to return to first position. But the block at "B," by preventing contraction there, prevents free expansion at "A" and causes the metal, which is soft at the high temperatures, to be upset. On cooling, the contraction shortens the outside of the ell and pulls the flanges out. This principle is used in straightening up nipples on a manifold, but in this case expansion is opposed, not by wedges, but by the cold, opposite side of the nipple. The effect is always to draw the nipple over toward the heated side.

In welding the "bull" nipple on a tee, the contraction of the weld will always pull the flanges "A" and "B" toward each other at the top. To prevent this, the tee is strapped down to a short

piece of I beam and a shim about 3/8-in. thick put between I beam and tee in the center. You practically break the nipple back so that contraction will pull it straight. A simpler method of holding the end flanges, if they are of cast iron or cast steel is to put 2 bolts from flange to flange opposite the bull nipple and draw them up tight until the welding is done and parts cold. (Fig. 7.)

A bull plug, or short nipple, with the head welded in, is, geometrically, the intersection of two cylinders of the same diameter at right angles to each other. It follows from this, that the

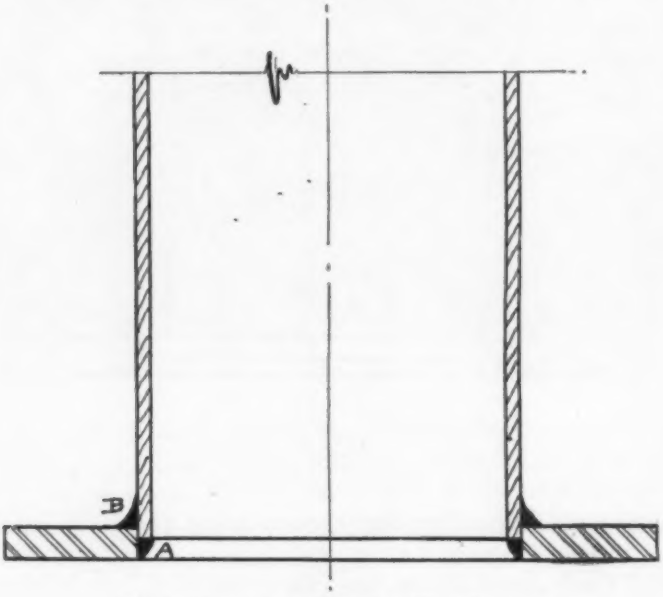


Fig. 5. Present method of welding flanges

piece fitted in for the top can be cut out of a piece of scrap pipe and does not need to be bent or shaped in any way. To facilitate welding, it is a good plan to trim the middle of each side of the top pattern by an amount equal to the thickness of the metal. Then the parts of the cap next to points "A" and "C" are beveled (Fig. 8).

In principle we have here two styles of head combined—at "B," like the flat head where there is a shearing strain on the weld (not good theoretically);—at "A" and "C," like the joint between a flanged head and cylinder where the weld is wholly in tension (the best theoretically). The result, practically, is a head strong enough for all work likely to be met, in practice, around an oil refinery and, probably in most other places. Any welder can make it, out on the job, with absolutely no other tools but a cutting and welding torch and the two patterns.

A swaged nipple or reducing nipple is made by cutting out

"V" shaped pieces around the circumference of a stub nipple (nipple with only one end threaded) at the stub end, knocking in the resulting tapering projections until they touch, welding up the seams thus formed, and welding a smaller sized stub nipple on the end.

Patterns for the triangular cuts can be made of rectangular 28-gage sheets to wrap around the pipe, with triangular pieces cut out. Care should be taken to have enough stock above and below the triangles so that the pattern will not "kink."

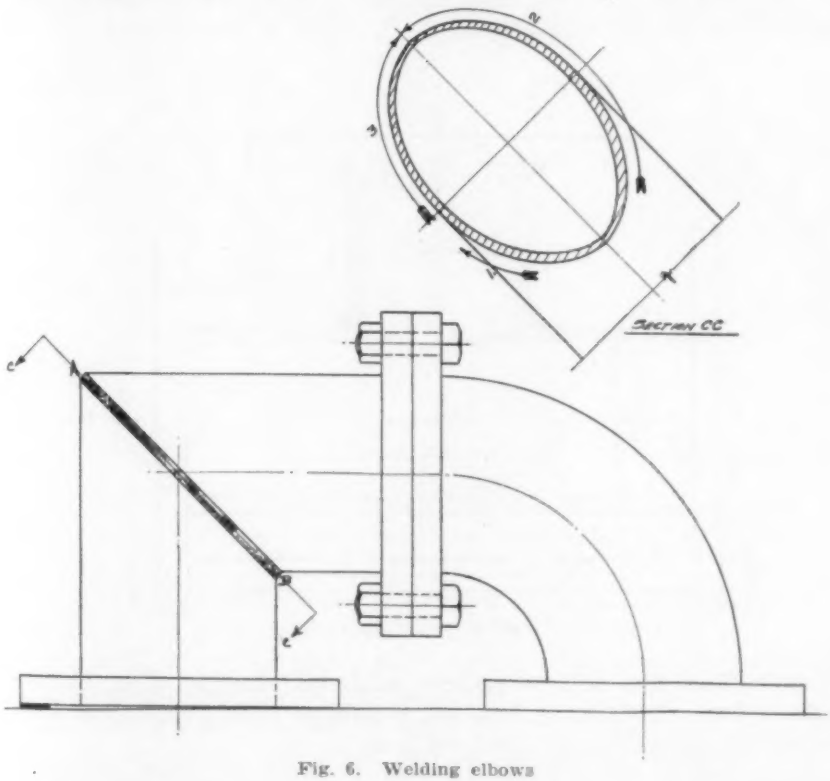


Fig. 6. Welding elbows

Fig. 9 shows the jig used for beveling nipples inside or outside, or cutting them square. An ordinary straight shank torch is used.

Offsets constructed between flanges whose faces are parallel are made very simply by using two welded ells.

Offsets whose flanges faces are not parallel are made either with boiler plate flanges, or with regular screwed flanges, using an adjustable template and an adjustable offset jig.

With the first method, plate flanges of suitable thickness are bolted to the flanges to be connected up. A piece of pipe is cut roughly so that it just enters each plate flange—to which it is then tacked. The pipe with its flanges is then taken out and

welded inside and outside each flange. If it is not permissible to tack in place, a line is scribed around the pipe next to each flange, center punch marks are made on flanges and pipe next to each other, and the whole offset taken to the shop, set in place, and welded.

Fig. 10 shows how an offset is made, using standard style flanges. A flanged stub nipple (A) is bolted in place. Cut a wedged shaped piece out of it, bend it down until it crosses the line of the other flanged end and cut off roughly on that line. Bolt a flanged stub at "B," just too short to touch pipe "A." With one hermaphrodite caliper leg on the stub end of "B," scribe a line around "A" as

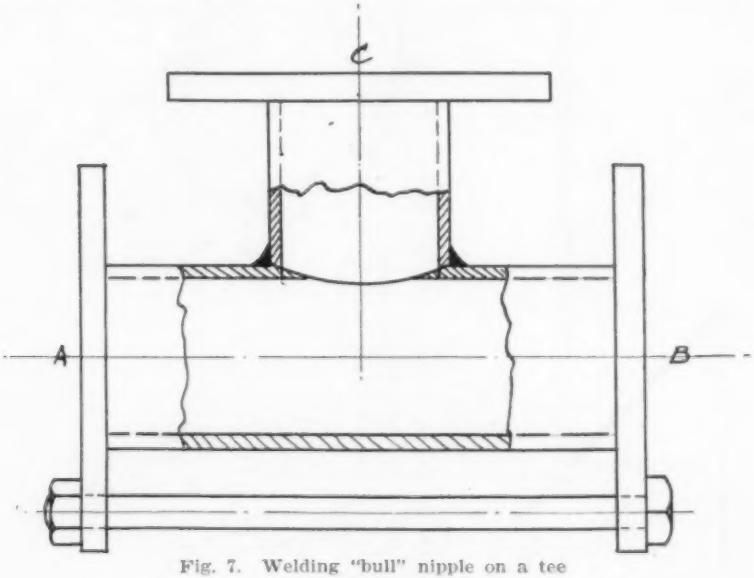


Fig. 7. Welding "bull" nipple on a tee

shown. This line will be parallel with "B" flange. Cut "A" on scribed line. Substitute for "B" a flanged stub nipple just long enough to reach this cut, and weld up.

But suppose we are not allowed to weld in place, as often happens in an oil refinery. We construct the offset in the shop in exactly the same way as we did in the field—in between two flanges "X" and "Y" set up exactly the angles that they had in the field. The jig used, shown in Figs. 11 and 12 is adjustable to any angle about both horizontal and vertical axes and is adjustable for length by simply sliding along I beams and clamping to them. Any size flange desired is fitted on a short stub nipple with two slots cut in it. A strap and bolt fasten the flanged stub to the angle plate and enable one to get the flange bolt holes in any position desired.

To set the jig to exactly duplicate position of flanges in the field, we set an adjustable template in the field in the place to

be occupied by the offset and transfer it to the shop. Suppose a rough measurement shows the offset to be 6 ft. 8 in. face to face. We adjust the turnbuckle so that it has three inches to go either way, and either splice in or cut out of the 1-in. pipe used enough to make the template 6 ft. 8 in. long. Then we bolt the template flanges to the pipe flanges on the job, lock the universal joints, adjust and lock the turnbuckle, take the template to the shop, and set the jig to exactly fit it. Note that any size flanges can be quickly fitted to both jig and template to construct an offset of any size pipe. Template flanges are of ½-in. plate tapped in

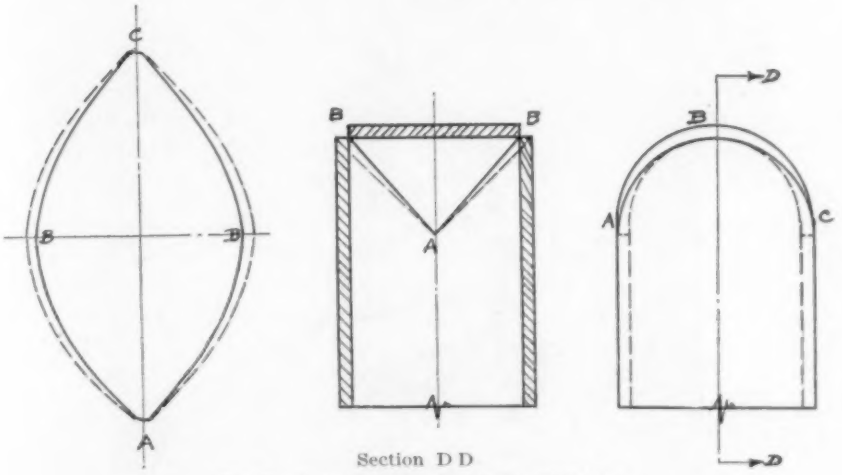


Fig. 8. Short nipple with head welded in

the center for 1-in. pipe and screw onto a bushing connected rigidly to the universal joint.

It might be well to add a word as to our practice in standardizing welding, cutting and laying out.

In laying out, we have a complete set of patterns (Fig. 13) for swage nipples, bull plugs and for the cut of every size pipe to intersect every other size of equal or larger diameter. These are made out of galvanized sheet iron unless there is little chance of the pattern being used more than once.

Furthermore, every welder, for temporary employment excepted, is expected to be able to make his own patterns and to lay out and set up all jobs.

Cutting and welding angle and channel frames from blue prints looks simple, but it takes considerable practice to know how much to allow for stretch and shrinkage in bending and welding corners, as much so as in welding sheets, pipe, or anything else. Naturally a welder accustomed to this work can lay it out with vastly more economy than a mechanic can who is trained in setting up machine work or riveted plates.

In cutting with the gas torch, close supervision is as necessary as in welding, for several reasons. In the first place the labor is less experienced. In the second place a good cutter can do two

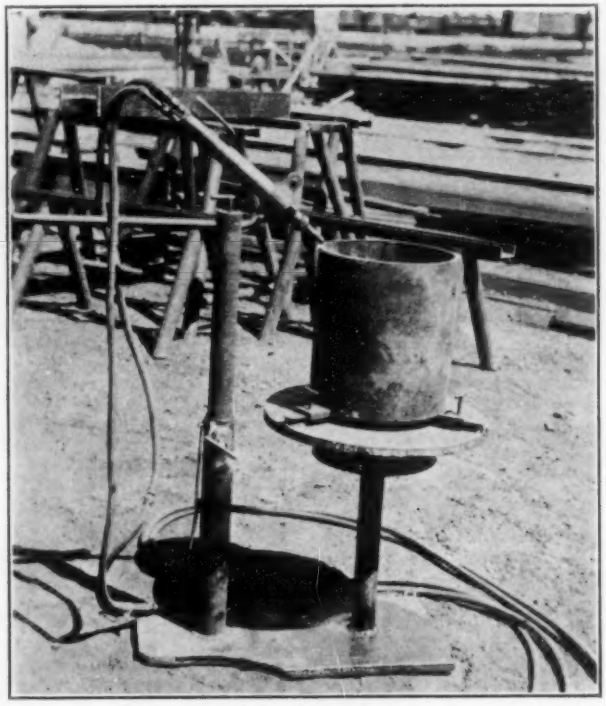


Fig. 9. Jig used for beveling

or three times as much as a green man with a smaller oxygen consumption per unit of area cut. Thirdly, pressures are higher and leaks are, therefore, much more costly. Fourth, tips and torches

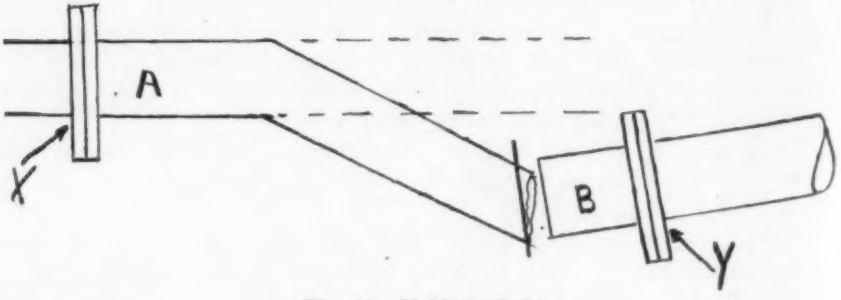
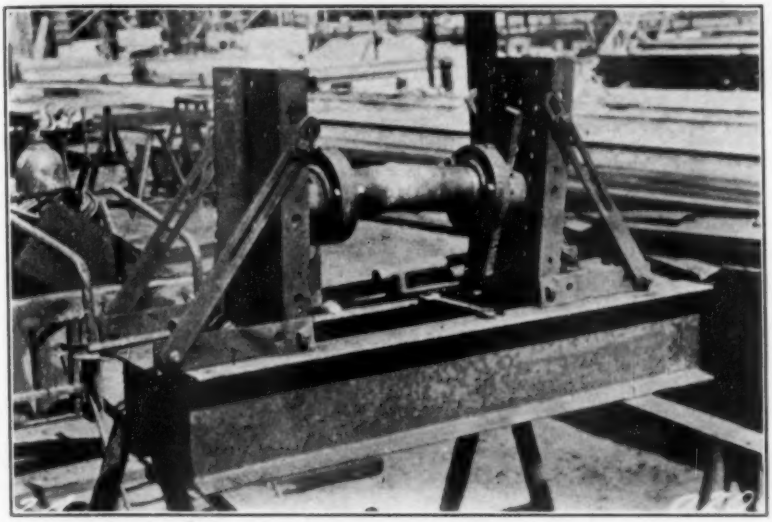


Fig. 10. Making offsets

are more complicated and need much more care than welding equipment.

Absolutely apart from any outside data, we find that a good



cutter uses about 3-10 cu. ft. of oxygen per square inch of steel cut. If he uses less, it cuts down his speed too much.

Parenthetically we might add that in making pipe cuts for elbows, etc., wherever possible it is better to use the power hacksaw, set on a miter, than the cutting torch.

Figs. 11 and 12. Special jigs and fittings welded with their use

To standardize time and gas costs we use forms indicating the consumption of each gas, and rods, and the time for welding. Reasons for unavoidable delay are also indicated. Extra high or low figures can be easily checked up. In practice, when using acetylene in portable cylinders, we find that cost of oxygen, acetylene, and rods in cents, is very close to oxygen pressure differences, in pounds, divided by two. For instance, if we start a

job with 1200 lb. in a 220 ft. oxygen cylinder and finish with 500 lb., our cost for gas and rods is very close to $\frac{1200—500}{2} = \$3.50$

To get gas cost in cutting, we divide by four instead of two. This takes into consideration the fact that acetylene cylinders can

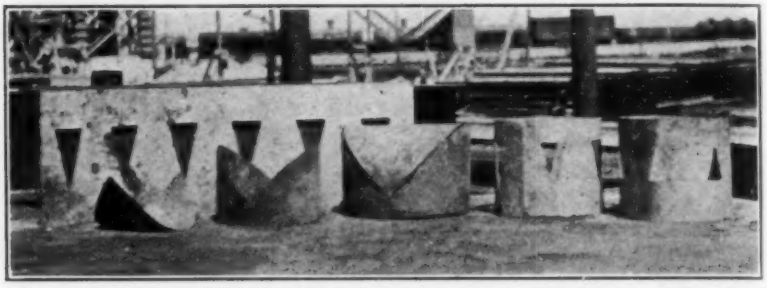


Fig. 13. Patterns for welding swage nipples

be used for cutting when they are too low in pressure for heavy welding.

Filling out data cards seems like a lot of trouble to the welder for a few days, but it soon becomes an automatic operation and gives him more interest in the work.

For help in working out the various ideas described, and in getting the material in form, I am under obligations to Mr. J. C. Bennett, engineer of the Associated Oil Co., and in the shop in working out jig details to E. Daniels, F. H. Huber and H. D. Long.

Notes on Welders' Safety Glasses and Accessories*

W. S. ANDREWS†

It is well known that the human eye is more sensitive to yellow and yellow-green light (wave lengths 5500—5700 A) than it is to light in other parts of the spectrum. As the intense glare of the iron arc produced in welding operations practically covers the entire visible spectrum, it is evident that to insure *the clearest definition of the work in hand, with the least possible amount of radiant energy and eye strain, a safety glass should transmit all of the yellow and yellow-green light rays* and exclude the others. Unfortunately, it does not seem possible to make a colored glass that will meet these requirements exactly, for the spectra of all

*From data furnished to the American Bureau of Welding in connection with its research information service.

†Consulting engineer, General Electric Co.

the safety glasses now on the market show a good fringe of orange and red on one side of the yellow, and, in most cases, a fringe of green on the other side of it. When this extra transparency is not too marked, however, it does not make the glass unacceptable.

The color of a safety glass, especially when observed by the unaided eye, naturally depends largely on the source of illumination, so the Bureau of Standards advises the use of a 200-watt, gas filled, tungsten filament lamp, operated at normal voltage, for the examination of these glasses. With this source of illumination, the general tint of a dark safety glass should be a brown or brownish green. If the brown is inclined to red, it is an indication that the glass transmits too much red light. Unaided visual observation of color, however, cannot be safely relied upon, for the true analysis of a compound color can only be made by a spectroscope.

Under spectroscopic observation with the above source of light, a dark safety lens, (say equivalent to No. 10 or 12 Noviweld) should transmit light consisting principally of wave lengths from 5300 A to 6300 A without any practically noticeable absorption bands within these limits. Several of the safety glasses now on the market conform substantially with these conditions.

Before the war, we were largely dependent on the foreign market for welders' safety glasses, and when this source of supply was cut off, we had to invent many makeshifts, as our home manufacturers had not then developed satisfactory substitutes. Various shades of home made ruby, yellow, green and blue glasses were combined to get a suitable density of color, with more or less success, but the building up of plate on plate for this purpose necessarily resulted in an undesirable weight of material, thus making helmets and shields cumbersome and tiresome to handle. Hundreds of screens were made in our company by packing colored gelatin and celluloid between two plates of clear glass, and excellent results were thus obtained as far as the transmission of light was concerned. Unfortunately, however, these screens deteriorated fast under the influence of the intense light and heat rays produced by the iron arc, so that their life was generally short. They served a useful purpose, however, when it was impossible to get more satisfactory substitutes.

In addition to transparency, or the transmission of visible light, glass also has the property of diathermancy or ability to transmit invisible heat rays. Glasses of different compositions, although their color densities may be alike, may vary in this respect from 2 per cent to 25 per cent. The National Safety Code, issued by the Bureau of Standards, does not attach much importance to this quality, but, other features being equal, preference should be given to the glass that shows the lowest degree of transmission of heat rays. It is the opinion of some ophthalmologists who

rank high in their profession, that continuous exposure of the eyes to heat rays may produce very serious injury, as evidenced in the disease known as "glassblower's cataract." The small gas jets used by glass blowers produce but little visible light, but are rich in heat rays, which are believed to be responsible for the disease in question, as it is not customary for glass blowers to use protective screens.

Ultra-violet light beginning at a wave length of 3050 A produces a destructive effect on living animal tissue especially when generated from such an intense source as the iron welding arc. It is therefore a *fortunate provision of nature that any ordinary glass of reasonable thickness (say 1/8 to 3-16 in.) provides a complete protection to the eyes,* as these rays are almost entirely excluded thereby. There is a tendency in some kinds of blue and violet glass to transmit ultra-violet rays, so it is desirable to avoid such glasses excepting for special purposes. Clear window glass absorbs these rays better than blue glass, but the dark brown and brown-green safety glasses are thoroughly effective in this respect. It must be carefully remembered in connection with spectacle lenses, that the so-called "pebble" lenses are made of clear quartz or natural rock crystal, and this material, being *transparent to ultra-violet rays, offers no protection against their harmful features.*

It goes without saying that no kind of structural defects are allowable in safety glasses. All lenses should be carefully inspected, and only those should be passed that are substantially free from striae, air bubbles, streaks and other flaws. Also all cover glasses should be renewed as soon as they become spotted or dull.

The first inspection of a safety glass should be made with the aid of a spectroscope, as previously stated. If found satisfactory, it then remains for the operator to select the shade or density of color that is best suited for his own particular sight and work. Acuity of vision varies considerably in different individuals, so that a man who has very good sight may get clear definition of his work with a glass that would be too dark for one whose eyes may not be so keen.

In order to protect the eyes as much as possible, *the darkest shade that shows a clear definition without any strain* should always be selected. If an operator uses spectacles or eye glasses in his ordinary work, they should not be discarded when he puts on his helmet or takes up his hand shield. When an operator can see his work clearly without feeling any strain or discomfort in his eyes, he may feel assured that they are safe from injury. It should not be forgotten, however, that too much light or glare may be quite as injurious as too little light, as the eye strain and unpleasant sensations in the eyes may be provoked in both cases.

Ordinary whitewash, made with lime, reflects a considerable amount of ultra-violet light. It is therefore desirable to paint the

walls of an arc welding shop with a non-reflective paint, as described in accompanying paper entitled "A paint that will not reflect Ultra-Violet Rays."

Summarizing the effective means for eye protection in arc welding work:

1. The intense glare and flickering of the arc should be softened and toned down by suitable colored glasses, selected by an expert, and having a depth of coloration which shows *the clearest definition combined with sufficient obscuration of glare.* This last feature can be best determined by the operator owing to individual differences in visual acuity.

2. Lenses should be carefully examined for structural defects, as these are prolific causes of eye strain, and general discomfort, when they come in the line of vision.

3. When cover glasses become spotted and dull, they should be replaced at once by new ones. It is desirable to keep a separate stock of cover glasses for this purpose.

CURRENT WELDING LITERATURE

Acetylene Welding, Ironmonger, Jan. 12, 1924, Vol. 179, p. 89.

Arc Welded Rail Bonds, Some Sidelights on, C. F. Gailor, Elect. Traction March, 1924, Vol. 20, pp. 142-4.

Arc Welder, Portable, Iron Age, April 10, 1924, Vol. 113, p. 1079.

Arc Welding, A. E. Cutler and P. A. Marsden, Brit. Pat. 209,180, Ill. Off. Jnl., Feb. 27, 1924, pp. 182-3.

Arc Welding Handbook, C. J. Holslag, published by McGraw-Hill Book Co. Table of contents: Preliminary Instructions and Holding the Arc; Bead Forming; Spreading Welding; Padding Welding; Overhead Welding; Fillet Welding; Lap Welding; Butt Welding; Special Butt Welds and Hole Filling; Irregular Tube Shapes; Tank Welding; Patching Sheets; Tank and Boiler Welding; Welding Heavy Sections; Welding Cast Iron and Malleable Iron; Welding Thin Sections in Cast Iron; Useful Arc Welding Methods and Their Application; Welding of Structural, Sheet Iron, Plate and Angle Work; Welding of Non-Ferrous Metals and Use of Carbon Arc; Electric Arc Cutting; Welding of Alloy Steels; Welding Test Pieces; The Electric Welding Arc and the Eyesight; Use of Gas, Electric and Thermit Welding, and Electrodes of Various Types; Rigidity vs. Flexibility in Arc Welding.

Arc Welding Sheet Metal Parts, A. R. Luechinger, Am. Machinist, March 20, 1924, Vol. 60, pp. 425-7. What constitutes good welding; proper methods of welding different kinds of seams; how welding operators should be trained; the use of fixtures in production welding.

Around the World by Air, Acetylene Journal, Vol. 25, June, 1924, pp. 585-589.

Autogenous Welding in Boiler Shops, Railway Journal, June, 1924, Vol. 30, p. 29.

Autogenous Welding of Steel. Uber die autogene Schweissung von Stahl. T. Kaütny, Auto. Metallbearb, Feb., 1924, Vol. 27, pp. 13-15.

Chromium Plating Steel, K. W. Schwartz, Chem. and Met. Engng., April 21, 1924, Vol. 30, pp. 627-8. From Am. Electrochemical Soc.

Cost of Automatic Welding of Crosshead Guides, Railway Age, June 18, 1924, Vol. 76, p. 1713.

Electric Arc Welding of Track Rails, G. Seguin, Canad. Pat. 238,491, Off. Rec., March 11, 1924, Vol. 52, p. 606.

Electric Seam Welders, Various Types of, J. R. Brueckner, Forg. Stamp. and Heat. Treat., March, 1924, Vol. 10, pp. 107-9.

Electric Welding Apparatus, A. E. Cutler and P. A. Marsden, N. Z. Pat. 28,745. Off. Jnl., Dec. 31, 1923, Vol. 12, pp. 674-5.

Electric Welding Machines, S. H. Gordon and Rose Street Foundry and Engng. Co., Ltd., Brit. Pat. 208,331, Ill. Off. Jnl., Feb. 6, 1924.

Fusion Welding of Pressure Vessels and Pipe Lines, S. W. Miller, Acetylene Journal, June, 1924, Vol. 25, pp. 592 and 596, 597.

How My Oxy-Acetylene Torch Makes Money, L. M. Bender, American Blacksmith, May, 1924.

Manufacturing Cutting and Welding Torches, Western Machinery World, Vol. 15, pp. 192-4, p. 192, June, 1924. Illustrating some of the shop equipment of the Victor Oxy-Acetylene Equipment Co. for quantity production of fuel gas torches.

Most Economical Method of Removing Firebox Sheets for Renewal. Describing Method, Is It More Economical to Renew Firebox Without Removing Boiler from Engine Frame? Railway Journal, Vol. 30, June, 1924, pp. 28-9.

New Portable Arc Welding, Pacific Marine Review, June, 1924, Vol. 21, p. 334.

Production Brazing, Welding Engineer, June, 1923, Vol. 9, pp. 17-20. B. Heyman. Careful attention to all the smallest details of process results in economical and satisfactory production.

Providing Safety in Electric Welding, D. H. Deyoe, Iron Trade Review, May 8, 1924, Vol. 54, p. 1235.

Report of Committee on Fusion Welding of the American Electric Railway Association. Steel and Steel Tired Wheels, Rolled Steel Wheels, Axles, Couplers, Low Carbon Steel, Wrought Iron, Cast Iron, Cast Iron Wheels, Non-Ferrous Metal, Torch Cutting, Revision of Gas and Electric Welding Limits and Regulations of Report, 1919.

Scrapping Steel Freight Cars, A. M. Candy, Welding Engineer, June, 1924, Vol. 9, pp. 21-23. Application of the electric arc cutting process to the reclaiming and scrapping of rolling stock.

Seam Welding Method and Apparatus, F. S. Youtsey, U. S. Pat. 1,487,043, Off. Gaz., March 18, 1924, Vol. 320, p. 562.

Stellite Welding, H. Ullmert, Canad. Machinery, April 17, 1924, Vol. 31, p. 25. Temperature for work; Avoid blow holes; Less heat required.

The manufacture of Centrifugal Cast Iron Pipe, Acetylene Journal, June, 1924, Vol. 25, pp. 590-592. An interesting process with which the gas welding industry should be familiar.

Using the Arc with Safety, D. H. Deyoe, Welding Engineer, Vol. 9, p. 28. Protection of the Eyes and Body, Welding Booths.

Welded Joints? How Efficient Are, E. E. Michaels, Contr. Rec. and Engrg. Rev., April 2, 1924, Vol. 38, pp. 327-9. Tests conducted by the Chicago Bridge and Iron Works determine the efficiencies of various types of joints, results obtained provide excellent design data.

Welding Apparatus, Electro-Percussive, C. F. Allcutt, U. S. Pat. 1,490,191, Off. Gaz., April 15, 1924, Vol. 321, p. 561.

Welding at an Ore Dock, R. K. Randall, Welding Engineer, Vol. 9, p. 29, June, 1924. How the arc and torch work side by side; Keeping massive machine parts in order.

Welding Cast or Malleable Iron, A. H. Jansson, Iron Trade Review, June 19, 1924, Vol. 74, pp. 1632-33. Welding cast iron, scientific explanation, compound prevents oxidation.

Welding Locomotive Guide Rods, Western Machinery World, Vol. 15, p. 188, June, 1924.

Welding Material for Building Up Worn Surfaces, Railway Age, June 18, 1924, Vol. 76, p. 1714.

Welding Men Hold Meeting, Railway Age, June 10, 1924, Vol. 76, p. 706.

Welding Standardization in Locomotive Shops, J. S. Heaton, Rly. Mech. Engr., April, 1924, Vol. 98, pp. 231-4. Frames and motion work. Piston heads, crossheads and valve bushings, repairing cracked cylinders, stoker repair work, superheater units, rod brasses and driving boxes, broken wheel spokes and tires, reclamation work, acetylene welding, torches:

Welding Tubes, F. G. Gale and P. W. Shaw, Brit. Pat. 208,300. Ill. Off. Jnl., Feb. 6, 1924.

Westinghouse Welding Set, Railway Age, Vol. 76, June, 1924, p. 171.

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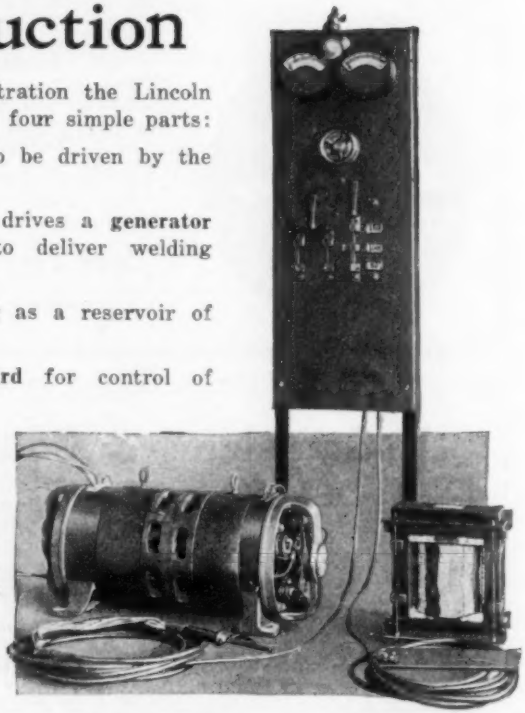

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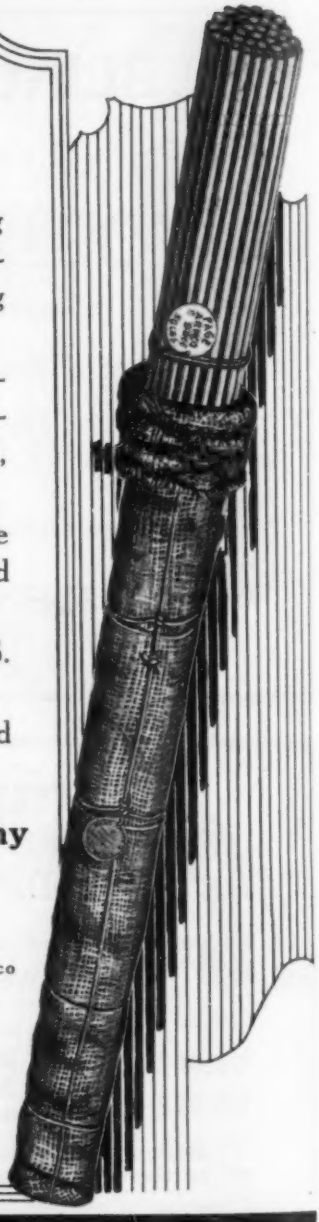

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ASK your master mechanic or welding foreman to check your oxy-acetylene welding and cutting apparatus. How much of it is in service and how much needs repair?

You know that all the machinery and apparatus in your plant requires constant adjustment and sometimes repair. This is the result of use, and occasionally, of abuse. Your oxy-acetylene equipment is no exception.

If your welding and cutting equipment is Oxweld, repairs and adjustments are not a source of worry. You know that Oxweld fieldmen inspect it from time to time, make adjustments, and supervise minor repairs. You know also that near you is one of the Oxweld factory repair stations, which makes major repairs. It is not necessary to ship your apparatus to our factory, because the repair stations listed at the left can do equally good work in much less time.

In buying oxy-acetylene equipment, consider the nearness of repair service. Later, this will be important to you. Oxweld apparatus, including these repair facilities and other services, requires only a moderate investment.

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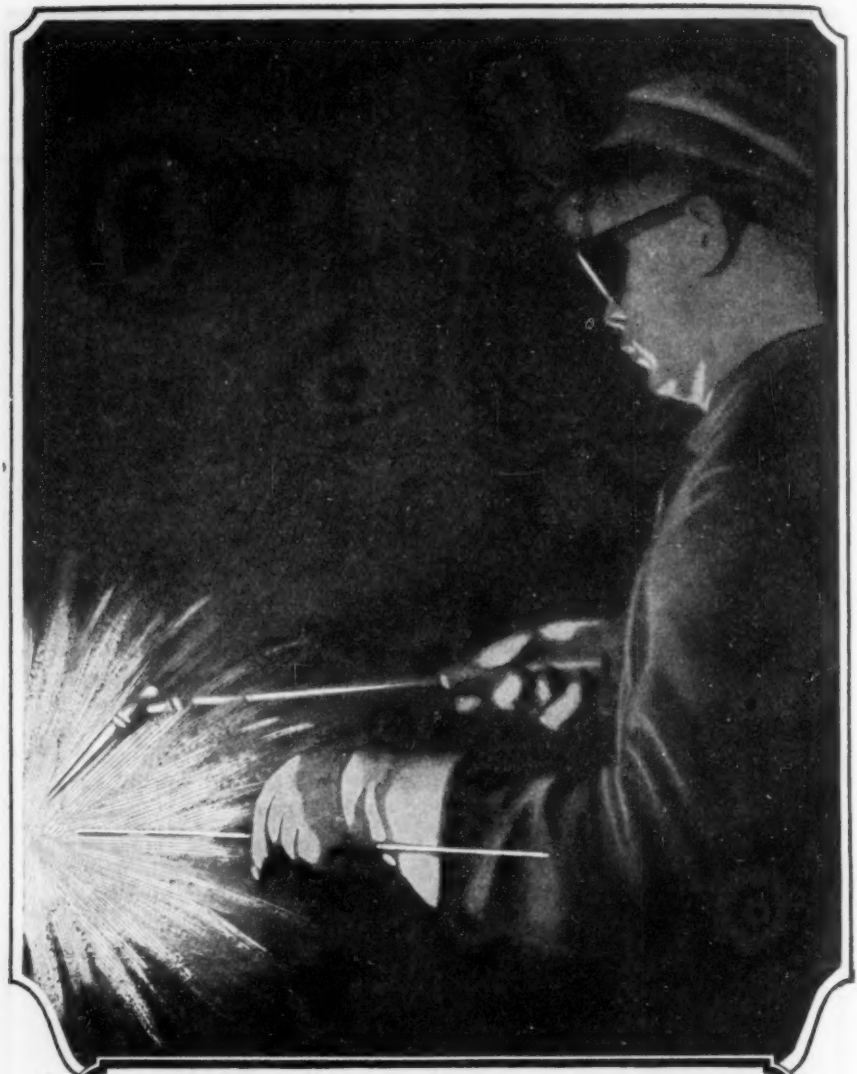

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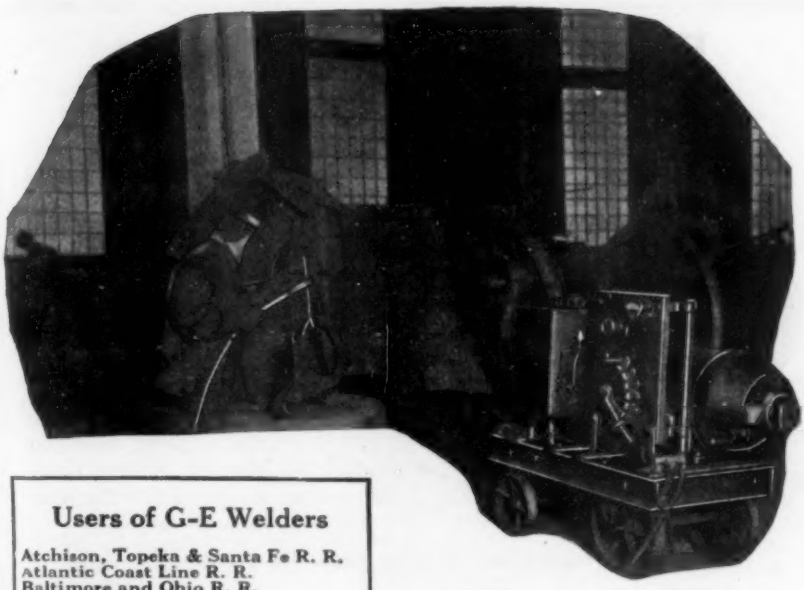

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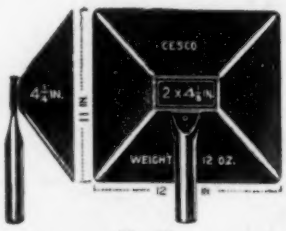

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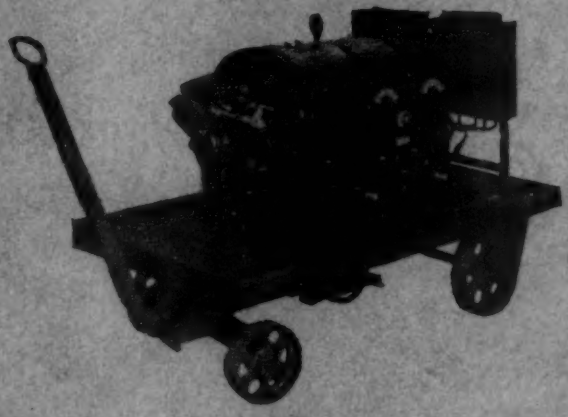

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